Republic of the Philippines
Department of Education
Cordillera Administrative Region
Schools Division of Benguet
TUBA NATIONAL HIGH SCHOOL
Penged, Nangalisan, Tuba, Benguet

Innovation Proposal Title:

Electronegativity Board Game

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PROJECT DURATION
July 2019 – March 2020/October 2020 – July 2021

I. EXECUTIVE SUMMARY

Electronegativity Board Game is designed for Senior High School learners which aims to improve the mastery of the lesson on Polarity (S11/12PS-IIIc-15 Determines if a molecule is polar or non-polar given its structure), one of the topics discussed in Physical Science subject for Senior High School, in a fun and interactive way. Specifically, it aims to increase mastery and retention on specific learning objectives in which the learner is able to a) differentiate anion from cation, b) write chemical formula of compounds, c) enumerate diatomic molecules, d) compute for electronegativity differences of compounds, and e) identify the polarity of a compound using its electronegativity.

The innovation was conceptualized and implemented last school year 2019 – 2020. Its use in the teaching learning process was observed by Ma'am Beatriz J. Luquey, a Master Teacher, last January 21, 2020, and by Ma'am Teresita S. Tillama, a School Principal, last January 24, 2020. It was also validated by Ma'am Georgina C. Ducayso, EPS-Science, last February 27, 2020, but due to the complications brought by the COVID-19 pandemic, the completion of its terminal report was put on hold to further adapt on the changes in the education system.

Based on the observation reports, the game is engaging, promotes collaborative learning and teamwork, and manifested positive behavior among the learners. As matter of fact, it was observed that the learners were actively engaged on the game. The game also integrates and develops language, literacy, and quantitative (mathematics) skills of the learners. Furthermore, the game could be replicated to other science topics specially in chemistry concepts. To better the students' performance in the game, mastery on the prior knowledge is very much needed. It was also suggested that incorporation of scrabble mechanics be used.

From the validation report, it was found out that the game could be used for Grade 8, 9, and 10 learners. It was also recommended that the material used could be submitted for Learning Resource evaluation. Moreover, it was also recommended that the game be implemented in two different grade levels, hence, it could be subjected for action research.

Last third quarter of the school year 2020 – 2021, a 20-point written assessment on Polarity was given to Grade 12 learners to check on the impact of the Electronegativity Board Game on the retention and mastery of the lesson. These Grade 12 learners were the participants when they were Grade 11. Result of the assessment shows that among the 57 learners who have accomplished and submitted the written assessment, 10.53% (6) of learners has 75% (attained a score of 15-19) mastery and retention on the lesson, 71.93% (41) of the learners has 50% (attained a score of 10-14) mastery and retention, and 17.54% (10) of the learners has 25% (attained a score of 5-9) master and retention on the lesson.

II. INTRODUCTION AND JUSTIFICATION

Mastering a certain concept or skill is one of the toughest tasks to do. As teachers, we are tasked to make it to a point that learners show mastery of concepts being taught and be able to apply them in real-life situations. Thus, we try to make our teaching-learning process simplified, contextualized and fun. This is when various strategies and techniques come in.

Polarity is one of the topics discussed in one of the Senior High School subjects, Physical Science. This is also a topic discussed in Grade 9 Chemistry. As a senior high school teacher, it has always been a challenge for me, sometimes a frustration, discussing the basics of this topic for it turns out that the learners have forgotten it. Also, the Grade 9 Science teacher has identified that the learning competencies on this topic is one of the least learned competencies for the past years. Having observed such, the teacher started conducting remedial classes where in re-teaching normally happens. Furthermore, the teacher spoke of looking for exciting activities to do on either teaching-learning hour or during remedial time. Such situation initiated my mind to come up with a certain game suitable for the topic.

Accordingly, games are ubiquitous part of life in our culture, and experts even more deeply embedded in the coming years. Games help people develop a disposition towards collaboration, problem-solving, communication, experimentation, and exploration of identities, all attributes that promote success in a rapidly-changing, information-based culture (2011 Harizon Report). Research into the cognitive and socio-cultural aspects of gaming has exploded in the last decade as people have begun to realize the potential for game-based learning (Gee, 2003 and Salen, 2007).

Furthermore, “playing games has strengthened teacher-student and student-student relationship at school, notes that students like games because they have fun and learn at the same time, and teachers like them because games help students build academic confidence as well as social and problem-solving skills,” says Marcia Baldanza, principal of Patrick Henry Elementary School in Alexandria, Virginia. Thus, if lessons on polarity, chemical formula, and electronegativity will be made into game, students could improve in their competence on such topics.

Different types of games have evolved. There are games which aim to increase content knowledge and this game, Electronegativity Board Game, is one of them. It aims to increase content knowledge and mastery level in the subject Chemistry, specifically on topics concerning polarity, ions, chemical bonding, and the periodic table of elements found in the learning competencies for grade 9 and senior high school.

III. GOALS AND OBJECTIVES

Generally, this innovation aims to introduce a certain board game that aims to help improve the mastery of on certain Grade 9 Chemistry learning competency (S9MT-IIa-13 Explain the formation of ionic and covalent bonds) and Grade 11 Physical Science learning competency (S11/12PS-IIIc-15), Determines if a molecule is polar or non-polar given its structure) leading to prolonged retention of learning. Specifically, it aims to increase mastery and retention on specific learning objectives in which the learner is able to:

a. Differentiate anion from cation,
b. Write chemical formula of compounds,
c. Enumerate diatomic molecules,
d. Compute for electronegativity differences of compounds, and
e. Identify the polarity of a compound using its electronegativity.

IV. PROJECT TARGET AND BENEFICIARIES

Project Target:

At the end of the project, at least 75% of the Grade 11 learners will manifest mastery of the identified Chemistry 9 and Physical Science for Senior High School learning competencies.

Project Beneficiaries:

The beneficiaries of this project are Grade 9 and Grade 11 learners.

V. PROJECT DESCRIPTION

Electronegativity Board Game targets the following learning competencies: S9MT-IIa-13 The learner explains the formation of ionic and covalent bonds and (S11/12PS-IIIc-15) The learner determines if a molecule is polar or non-polar given its structure.

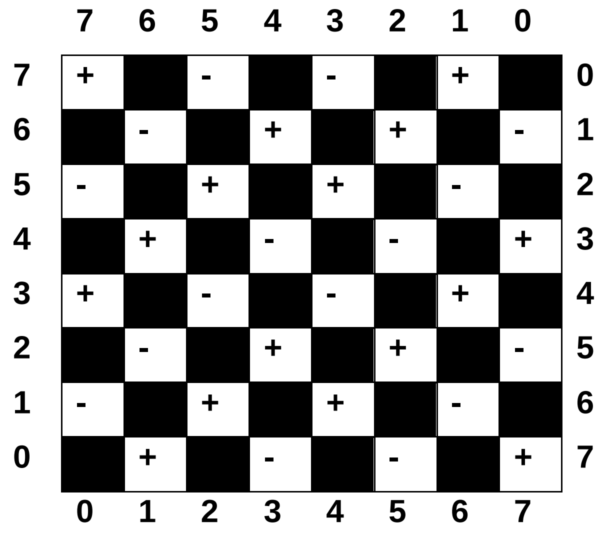
The said innovation could be utilized during the teaching learning process as a performance task activity or task to be given for students during remedial classes. Moreover, this could also be used as a board game for Senior High School following the mechanics of the game, which could be played during Math and Science Competitions.

The board game is patterned to the classic sci-dama game with certain differences when it comes to the chips, scoring, and rules (details are explained below). The concept of scrabble could also be added to make the game even more fun and challenging.

GAME MECHANICS

Materials Needed:

a. 8 by 8 board with addition and subtraction signs created in a 1/4 sized illustration board or on a folder.



	7	6	5	4	3	2	1	0	
7	+	■	-	■	-	■	+	■	0
6	■	-	■	+	■	+	■	-	1
5	-	■	+	■	+	■	-	■	2
4	■	+	■	-	■	-	■	+	3
3	+	■	-	■	-	■	+	■	4
2	■	-	■	+	■	+	■	-	5
1	-	■	+	■	+	■	-	■	6
0	■	+	■	-	■	-	■	+	7
	0	1	2	3	4	5	6	7	

b. Chips containing the symbol, electronegativity, and ionic charge of the following elements:

   i. Hydrogen, Oxygen, Nitrogen, Chlorine, Iodine, and Bromine. At the back of each will be Fluorine.

±1 **H_2** 2.20	-2 **O_2** 3.44	-3 **N_2** 3.04	-1 **Cl_2** 3.16	-1 **I_2** 2.66	-1 **Br_2** 2.96	-1 **F_2** 3.98

   ii. Aluminium, Potassium, Silver, Magnesium, Sodium, and Calcium. At the back of each will be Francium.

+3 **Al** 1.61	+1 **K** 0.82	+1 **Ag** 1.93	+2 **Mg** 1.31	+1 **Na** 0.93	+2 **Ca** 1.00	+1 **Fr** 0.70

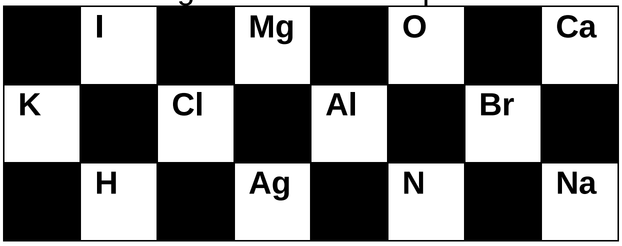
c. Score sheets

Move	**Chemical Equation**	**Bond Polarity**

d. Calculator (optional), timer, and pen

Rules:

1. The game adopts the game rules of sci-damath game but considering specific details that are as follows:
   a. Arrangement of the chips.



■	**I**	■	**Mg**	■	**O**	■	**Ca**
K	■	**Cl**	■	**Al**	■	**Br**	■
■	**H**	■	**Ag**	■	**N**	■	**Na**

b. A chip is declared dama upon reaching terminally on the following designated squares: (1,7), (3,7), (5,7), and (7,7). Thus, either of the following may happen;
   i. If either of the chips containing the elements Hydrogen, Oxygen, Nitrogen, Chlorine, Iodine, and Bromine which are anions is declared dama, the chip is flipped and changes its value into Fluorine, and
   ii. If either of the chips containing the elements Aluminium, Potassium, Silver, Magnesium, Sodium, and Calcium which are cations is declared dama, the chip is flipped and changes its value into Francium.

c. In taking the opponent's chip, if the takers chip landed on the minus sign (-), it is automatically NO SCORE for it signals no reaction will happen between the two elements.

d. In taking the opponent's chip, if the takers chip landed on plus sign (+), the following is to be considered.
   i. Cation + Anion = With Reaction/WITH SCORE
   ii. Cation + Cation = No reaction/NO SCORE
   iii. Anion + Anion = No Reaction/NO SCORE but is a certain Anion takes the same Anion (ex. Br_2 + Br_2) = With Reaction/ WITH SCORE
   iv. Hydrogen is a special chip because it has a + and – charge, thus,

Hydrogen + Cation = With Reaction/WITH SCORE
Hydrogen + Anion = With Reaction/WITH SCORE

e. In taking the opponent's chip, if the takers chip is a dama or if the eaten chip is dama, the score will be doubled and if a dama chip takes on a dama chip, the score will be quadrupled.

f. A player has a maximum of 1 minute each turn. Accomplishment of the score sheet is included.

g. This will be the scoring system

Electronegativity Difference	**Type of Bond Polarity**	**Score Allotted**
Less than 0.4	Non Polar Covalent	1 point
Greater than 0.4 to 1.5	Polar Covalent	2 points
Between 1.5 and 2.0 (between non-metals)	Polar Covalent	2 points
Between 1.5 and 2.0 (metal and non-metal)	Ionic	3 points
Greater than 2.0	Ionic	3 points

h. If the game has ended and there are chips left the following conditions apply.

    i. If the following elements Hydrogen, Oxygen, Nitrogen, Chlorine, Iodine, and Bromine which are anions are the remaining chips, additional 1 point is added to the total score of the player and if Fluorine is the remaining chip then addition 2 points is given. (The following elements are diatoms and the bond present in diatoms is non-polar covalent)
    ii. If the following elements Aluminium, Potassium, Silver, Magnesium, Sodium, Calcium and Francium which are cations are the remaining chips, no additional points will be given.

i. In using the score sheets

Move	**Chemical Equation**	**Bond Polarity**
This is the portion where the movement of the chips will be placed together with their corresponding coordinates.	The player would identify if there will be a reaction or not. Thus, if there is a reaction between the ions, the reaction should be shown.	Computation of the electronegativity difference is shown and

j. In declaring the winner, the player with the lowest total score wins. If both has equal score, then the player to score first, as reflected in the score sheet, losses.
***Sample accomplished score sheet.

Move	**Chemical Equation**	**Bond Polarity**
I_2 (3,0)		
Mg (1,4)	$Mg^{+2} + Ca^{+2}$ = No Reaction	
O_2 (4,3)		
Al (6,3)	$Al^{+3} + Mg^{+2}$ = No Reaction	
Al (4,5)	$Al^{+3} + I^{-1} = AlI_3$	2.66 – 1.61 = 1.05 (Polar)
Mg (3,6)	$Mg^{+2} + O^{-1} = MgO_2$	3.44 – 1.31 = 2.13 (Ionic)
Cl_2 (4,1)		
Ca (5,4)	$Ca^{+2} + Al^{+3}$ = No Reaction	
Ca (3,6)	$Ca^{+2} + N^{-1} = CaN_2$	3.04 – 1.00 = 2.04 (Ionic)
I_2 (1,4)		
Ag (1,2)		
H_2 (3,2)	$H^{\pm1} + Cl^{-1} = HCl$	3.16 – 2.20 = 0.96 (Polar)
	Remaining Chips:	Non Polar = 0
	Anions: Cl_2, Br_2, N_2, H_2	Polar = 2 x 2 = 4
	Cations: K, Na	Ionic = 2 x 3 = 6
		RC (anions) = 4 x 1 = 4
		Total Score **14 points**

VI. ACTIVITIES CONDUCTED

The table on pages 11 and 12 shows the list of activities and the exact date when the activity took place together with the necessary means of verifications to prove its conduct (see annexes).

Activities/ Tasks per Activity	**Individual/ Group Responsible**	**MOV/s**	**Date Accomplished**
I. Start-up Phase			
A. Proposal making	Subject Teacher	Approved Proposal	July 22, 2019
B. Consultation	Subject Teacher, Master Teachers, and School Principal		July 23, 2019
C. Finalization of Proposal	Subject Teacher		September 5, 2019
D. Submission of Proposal	School Principal		October 4, 2019 October 8, 2019
E. Approval of Proposal	Education Program Supervisors, Chief Education Supervisors, Schools Division Superintendent.		October 29, 2019 November 4, 2019
F. Procurement of needed Instructional Materials	Subject Teacher		December 13, 2019
G. Preparation and Instructional Material Making.	Subject Teacher and Grade 11 Students		January 10, 2020
II. Implementation Phase			
A. Discussion of the Competency	Subject Teacher	Daily Lesson Log and the Observation Tool used by the Master Teacher.	January 20, 2020

B. Orientation about the Board Game	Subject Teacher		January 21, 2020
C. Gaming Proper	Subject Teacher and Grade 11 Students ***EPS-Science will observe	Daily Lesson Log and the Observation Tool used by the School Principal, Pictures, and Score Sheets.	January 24, 2020
		Daily Lesson Log and the Validation Form Used by the Education Program Supervisor for Science, Pictures, and Score Sheets.	February 27, 2020
D. Test Administration (Mastery and Retention Check)	Subject Teacher	Summarized scores of the learners on the written assessment.	April 19, 2021
III. Completion Phase			
A. Post Conference	Subject Teacher, Grade 11 Students, Master Teachers, School Principal	Terminal Report of the Innovation	January, 21, 24, and February 27, 2020
B. Accomplishment of Evaluation Report	Subject Teacher		August 10, 2021
C. Submission of Report to the Division Office.	School Principal		August 11, 2021

VII. HIGHLIGHTS OF ACCOMPLISHMENT

Electronegativity Board Game is a fun and interactive game which is designed for Senior High School learners. It aims to improve the mastery of the lesson on Polarity. Polarity is one of the topics discussed in Physical Science subject for Senior High School. This innovation also aims to introduce a sci-dama boardgame for Senior High School which could be played during the month of September for the Science and Math Festival.

The innovation was conceptualized and implemented last school year 2019 – 2020. Its use in the teaching learning process was observed by Ma’am Beatriz J. Luquey, a Master Teacher, last January 21, 2020, and by Ma’am Teresita S. Tillama, a School Principal, last January 24, 2020. It was also validated by Ma’am Georgina C. Ducayso, EPS-Science, last February 27, 2020.

Based on the observation reports, the game is engaging, promotes collaborative learning and teamwork, and manifested positive behavior among the learners. As matter of fact, it was observed that the learners were actively engaged on the game. The game also integrates and develops language, literacy, and quantitative (mathematics) skills of the learners. Furthermore, the game could be replicated to other science topics specially in chemistry concepts. To better the students’ performance in the game, mastery on the prior knowledge is very much needed. It was also suggested that incorporation of scrabble mechanics be used.

From the validation report, it was found out that the game could be used for Grade 8, 9, and 10 learners. It was also recommended that the material used could be submitted for Learning Resource evaluation. Moreover, it was also recommended that the game be implemented in two different grade levels, hence, it could be subjected for action research.

Last third quarter of the school year 2020 – 2021, a 20-point written assessment on Polarity was given to Grade 12 learners to check on the impact of the Electronegativity Board Game on the retention and mastery of the lesson. These Grade 12 learners were the participants when they were Grade 11. Result of the assessment shows that among the 57 learners who have accomplished and submitted the written assessment, 10.53% (6) of learners has 75% (attained a score of 15-19) mastery and retention on the lesson, 71.93% (41) of the learners has 50% (attained a score of 10-14) mastery and retention, and 17.54% (10) of the learners has 25% (attained a score of 5-9) master and retention on the lesson.

Results of the assessment conducted implies increased mastery and retention on the topic. Thus, it can be concluded that the electronegativity board game is indeed effective. It is therefore recommended for its use in classroom instruction.

VIII. SUSTAINABILITY

Activities	Role of Stakeholders	Resources Needed	Support from Stakeholders
Classroom Instruction (Performance task for the topic on Polarity)	Donate finances for multiple reproduction of Instructional Materials (Board and Chips)	Board and Chips, Pen, and Paper	Financial donations for Multiple Reproduction of materials needed.
Sci-dama Game Competition for Senior High School learners every September during the conduct of Science and Math Festival.	Donate finances materials, and prizes needed.	Board and Chips, Pen, and Paper	Financial Donations for materials, and prizes needed.

IX. BUDGET UTILIZATION

Activities/ Tasks per Activity	Resources Needed	Cost and Source of Fund
I. Start-up Phase		
A. Proposal making	Bond Paper and Ink	Materials were given by the supply officer.
B. Consultation		
C. Finalization of Proposal	Bond Paper, Ink, Folder, and Bland CD	Materials were given by the supply officer.
D. Submission of Proposal		
E. Approval of Proposal		
F. Procurement of needed Instructional Materials		
G. Preparation and Instructional Material Making. (Board and Chips)	Tarpaulin Printing Folders Pen Crayons	1,000.00 pesos 300.00 pesos 250.00 pesos 250.00 pesos (Personal Expenses)
II. Implementation Phase		
A. Discussion of the Competency		

B. Orientation about the Board Game		
C. Gaming Proper		
D. Test Administration (Mastery and Retention Check)	Bond Paper and Ink	Materials were given by the supply officer.
III. Completion Phase		
A. Post Conference		
B. Accomplishment of Evaluation Report	Bond Paper, Ink, and Folder	Materials were given by the supply officer.
C. Submission of Report to the Division Office.		
	TOTAL COST	1,800.00 pesos

X. MONITORING AND EVALUATION

Project Target:

At the end of the project, at least 75% of the Grade 11 learners will manifest mastery of the identified Chemistry 9 and Physical Science for Senior High School learning competencies.

Project Beneficiaries:

The beneficiaries of this project are Grade 9 and Grade 11 learners.

Note: See next pages for the details.

Activities/ Tasks per Activity	**Physical Targets**			**Time Targets**		
	Target	Actual Result	Percent Accomplished	Target date of Monitoring	Actual Date of Monitoring	Remarks
I. Start-up Phase						
A. Proposal making	Creating the draft of proposal.	Printed innovation proposal	6.25%	July 2019 to September 2019	July 22, 2019	Draft was printed and were forwarded to the Master Teachers.
B. Consultation	Checking of the Draft with the Master Teachers.	Draft was checked, and comments were noted.	12.5%		July 23, 2019	Suggestions for improvement were noted.
C. Finalization of Proposal	Input comments for improvement of the Master Teachers.	Final draft was printed.	18.75%		September 5, 2019	The proposal was finalized.
D. Submission of Proposal	Submit Proposal to the Division Office.	Proposal was submitted by the School Principal	25%	October 2019 to November 2019	October 4, 2019	Received by the Division Office.
					October 8, 2019	Reviewed by the Education Program Supervisors. Accordingly,

						certain parts needs editing.
E. Approval of Proposal		Proposal was approved.	31.25%		October 29, 2019	Approved by the CES-CID.
			37.5%		November 4, 2019	The proposal was finalized and again was submitted to the Division Office.
F. Procurement of needed Instructional Materials	Look for suitable materials to be used.	Tarpaulin will be used.	43.75%	December 2019 to January 2020	December 23, 2019	Printing area for tarpaulin was identified.
G. Preparation and Instructional Material Making. (Board and Chips)	Drafting and finalization of the IMs.	The board made up of tarpaulin was printed.	50%		January 10, 2020	The tarpaulin (board) was printed.
II. Implementation Phase						
A. Discussion of the Competency	Discuss the lesson on Polarity.	The learning competency concerning Polarity was discussed.	56.25%	January 2020	January 20, 2020	The lesson was discussed.
B. Orientation about the Board Game	Introduction of the Board Game	The mechanics of the game were discussed.	62.5%		January 21, 2020	The game was introduced. The innovation was observed by a Master Teacher.

C. Gaming Proper	Game Time	6 rounds of games happened.	68.75%		January 24, 2020	The innovation was observed by a School Principal.
			75%		February 27, 2020	Validation of the innovation happened.
D. Test Administration (Mastery and Retention Check)	Administration of w 20-pt. Written Assessment.	57 out of 67 students responded.	81.25%		April 19, 2021	Administration of the 20-point written assessment. It took a long time due to the COVID-19 pandemic and due to certain changes in the academic system.
III. Completion Phase						
A. Post Conference	Give out comments and suggestions.	Comments and suggestions by the observers/ validators were noted.	87.5%	January 2020	January 21, 24, and February 27, 2020	This happened write after the observation and validation of the innovation.

B. Accomplishment of Evaluation Report	Accomplish the evaluation or terminal report.	Accomplished the evaluation or terminal report.	93.75%	February 2020	August 10, 2021	The accomplishment of the evaluation or terminal report took a long time due to the COVID-19 pandemic and the changes in the academic system.
C. Submission of Report to the Division Office.	Submit at the District office the to the Division office.		100%		August 11, 2021	